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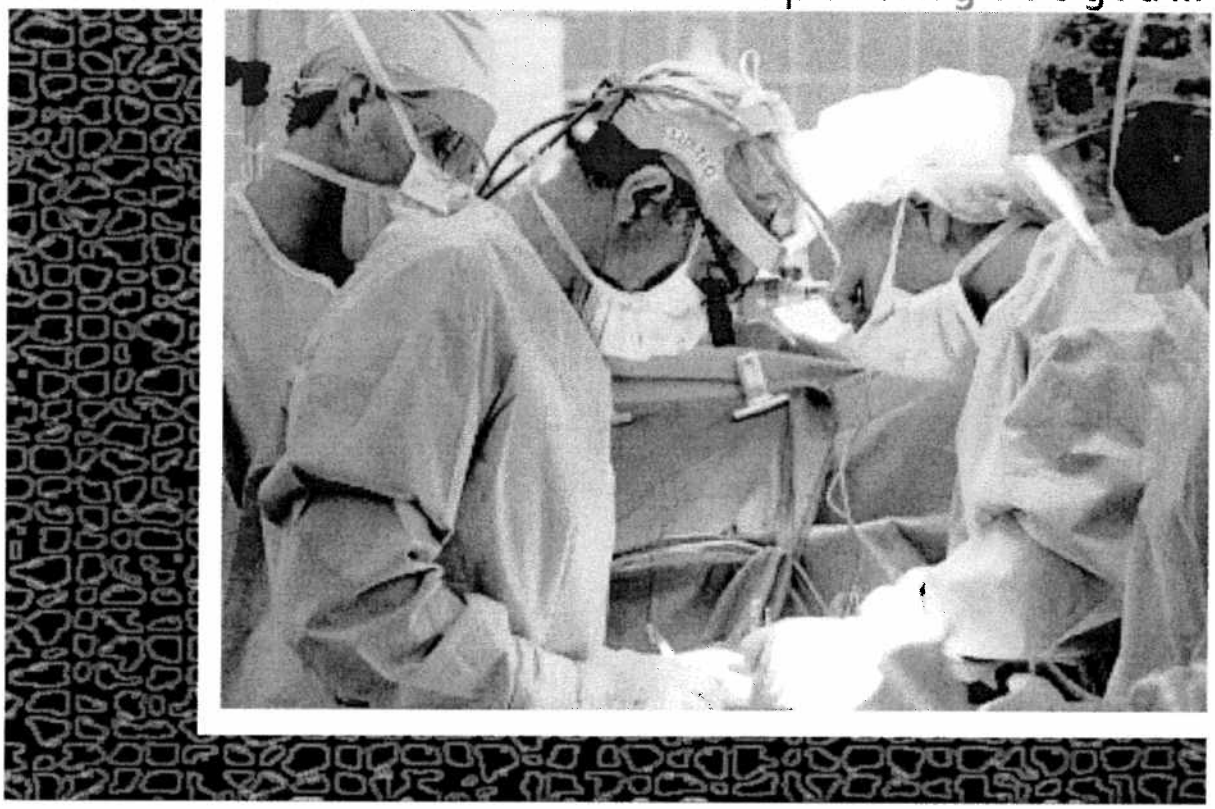
Coronary Artery Bypass Graft Surgery in California:

2003-2004 Hospital & Surgeon Data

California CABG Outcomes Reporting Program



Office of Statewide Health Planning and Development

The California Report on Coronary Artery Bypass Graft Surgery

2003-2004 Hospital and Surgeon Data

March 2007

THE CALIFORNIA REPORT ON CORONARY ARTERY BYPASS GRAFT SURGERY

2003-2004 Hospital and Surgeon Data

Office of Statewide Health Planning and Development

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Additional copies of the report can be obtained through the OSHPD Web site (www.oshpd.ca.gov).

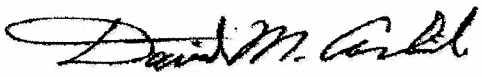
PREFACE

March 2007

With the release of this report, information on the quality of care provided by individual physicians in California is made public for the first time. The quality ratings of 302 cardiac surgeons who performed heart bypass surgery during 2003 and 2004 are listed inside. The quality ratings of the 121 hospitals where they performed these surgeries are also provided. Surgeons performed 40,377 isolated coronary artery bypass graft surgeries in California in 2003-2004, with an overall operative mortality rate of 3.08%. Isolated bypass surgery means that no other major heart procedure such as valve repair was performed at the same time.

This information is intended for cardiac patients and their families to use in developing treatment plans with their doctors. It is also intended for hospitals and surgeons to use in developing quality improvement activities and for organizations that purchase health coverage for their members. The clinical data collected and used to generate these findings are accurate and valid and the analytical methods rigorous. However, note that data beyond 2004 are not included, and surgeon and hospital practices may have changed since then.

Cardiac surgery providers in California and the Clinical Advisory Panel that oversees the heart bypass surgery reporting program are to be commended for the hard work and dedication they demonstrated in bringing this report to the public. The Office of Statewide Health Planning and Development continues to work with hospitals, physicians, and professional surgical societies to ensure that our reports are accurate, fair, and contribute to improved cardiac surgical care for all residents of the Golden State.



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I. INTRODUCTION

This report is a public disclosure of the quality of care provided by hospitals and surgeons performing coronary artery bypass graft (CABG) surgery in California during 2003 and 2004. It is the second heart bypass surgery report developed by the Office of Statewide Health Planning and Development (OSHPD) covering all of California's 121 state licensed hospitals where this procedure is performed, but it is the first report to detail results for all 302 responsible surgeons who performed the surgery.[4,5]

This report uses risk-adjusted operative mortality as the outcome measure. Operative mortality is defined as patient death occurring in the hospital after CABG surgery, regardless of the length of stay, or death occurring anywhere after hospital discharge but within 30 days of the CABG surgery. Use of operative mortality as the outcome, instead of in-hospital mortality, avoids potential manipulation of outcomes through discharge practices and holds hospitals and surgeons accountable for patients who died at home shortly after discharge or who were transferred and died in other facilities. The National Society for Thoracic Surgery (STS) also uses operative mortality as its primary outcome measure for CABG quality reporting although STS does not verify deaths following patient discharge. The National Quality Forum (NQF), which serves as the national body for vetting quality measures, has endorsed the STS operative mortality measure for CABG surgery.[6]

In this report, the operative mortality rate is adjusted statistically to account for variation in the health condition of patients before CABG surgery. The report is intended to encourage hospitals and surgeons to examine their surgical practices and make changes to improve the quality of care. This report also provides patients and their families with important information they may use when making decisions about CABG surgery.

Prior to this publication, all hospitals and surgeons listed in this report were provided an opportunity to review a preliminary version of this report showing their risk-adjusted results and performance ratings. Per statute, the two statements submitted by hospitals are included in this report and can be found in Appendix C. These statements may help readers better understand the concerns of some healthcare providers regarding the information released in this report.

During the preliminary report review period, surgeons were allowed to submit a statement to OSHPD if they felt their risk-adjusted results did not reflect the quality of care provided. Surgeons were also able to request review of subsequent decisions made by OSHPD to the California CABG Outcomes Reporting Program (CCORP) Clinical Advisory Panel (CAP), which is established in statute and responsible for reviewing and making final decisions on surgeon cases. Nine surgeons submitted 15 statements regarding their risk-adjusted results. In some instances the CAP upheld the decisions of OSHPD but in several instances they allowed surgeon requests for removal and revision of patient data. All surgeon requests for data changes were resolved prior to publication of this report.

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[4] This report provides details for the 302 licensed surgeons who performed isolated CABG surgery in 2003-2004. One surgeon who performed one non-isolated surgery is also noted in Table 5.

[5] The term "responsible surgeon" refers to the principle surgeon who performs the coronary artery bypass procedure. If a trainee performs this procedure, the responsible surgeon is the physician responsible for supervising the trainee. In situations where a responsible surgeon cannot otherwise be determined, the responsible surgeon is the surgeon who bills for the coronary artery bypass procedure.

[6] National Quality Forum (NQF), National Voluntary Consensus Standards for Hospital Care: Additional Priority Areas, 2005-2006, Washington, DC: NQF; 2006.

II. CORONARY ARTERY DISEASE AND BYPASS SURGERY

During 2003 and 2004, 232,748 Californians with coronary artery disease (CAD) were admitted to hospitals, which represents 8.5% of all adult non-maternal admissions. For adult non-maternal patients, heart disease was the leading cause of admission to hospitals in California.[7]

Coronary artery disease is a chronic disease in which cholesterol and fat solidify and form plaque along the linings of the coronary arteries. This process is called atherosclerosis or hardening of the arteries. If plaque continues to build up, blood vessels can become partially or completely blocked so the heart does not receive enough oxygen, leading to angina (chest pain) or even myocardial infarction (heart attack).

The two most common procedures for the treatment of coronary artery disease are Percutaneous Coronary Intervention (PCI), which includes drug-eluting stents, and Coronary Artery Bypass Graft (CABG) surgery. Despite recent large increases in the number of PCI procedures performed, CABG surgery is more frequently recommended for patients with extensive coronary disease, reduced left ventricular function, and more severe angina.

During CABG surgery, the surgeon uses arteries or veins from another part of the body (e.g., the saphenous vein from the leg) to reroute blood around a blockage in the coronary arteries. This allows oxygen-rich blood to flow freely to nourish the heart muscle. Surgeons may create single or multiple grafts for patients, depending on how many blood vessels and main branches are blocked.

Study Population

Under state mandate, California-licensed hospitals are required to report all isolated and non-isolated CABG surgeries to CCORP. Isolated CABG surgery is defined as CABG surgery performed without other major heart procedures, such as valve repair, during the same surgery (see Appendix A for the clinical definition of isolated CABG surgery).

In 2003 and 2004, there were 49,435 adult CABG surgeries performed in California; of these, 40,377 (82%) were isolated CABG surgeries, and 9,058 (18%) were non-isolated CABG surgeries. The study population for this report consists of all adult patients who underwent isolated CABG surgery and were discharged in 2003 and 2004. Isolated CABG surgery cases were selected as the study population because the uniformity of the surgical process allows adequate pre-operative risk adjustment for patient conditions. Non-isolated CABG cases were not used to determine hospital and surgeon performance ratings in this report.

[7] Data source: OSHPD, Patient Discharge Data, 2003 and 2004. Patients were identified with CAD if the principal diagnosis was coded as ICD-9-CM 410.0 - 414.9.

III. DATA

The primary data source for this report is the 2003 and 2004 clinical registry data collected by CCORP from reporting hospitals. These data were linked to vital statistics data from the California Department of Health Services to identify patients who died at home or at facilities other than the operating hospital within the 30 days following CABG surgery.

The CCORP clinical data registry draws on a subset of data elements collected by the Society of Thoracic Surgeons (STS) for their National Database of Cardiac Surgery. However, some data elements are exclusive to CCORP. Although the STS and the CCORP data definitions are virtually identical, CCORP provided additional clarifications to assist hospitals with coding. The data elements collected by CCORP in 2003-2004 and their definitions can be found in Appendix B.

Data Quality Review and Verification

The data submitted by each hospital were reviewed for completeness and errors. Prior to the hospital medical chart audit, a two-step process was followed to verify data submissions.

Step 1: Data Quality Reports

This process compares hospital and surgeon-specific prevalence rates for each preoperative risk factor to the state average, highlighting possible reporting issues for hospitals to address. Checks for invalid, missing, and abnormally high or low risk factor values are also included in these summary reports, which are distributed to hospitals for review and data correction.

Step 2: Data Discrepancy Reports

This process compares the CCORP data to the OSHPD Patient Discharge Data (PDD) files, requiring hospitals to account for discrepancies between the two data sources via chart review. This includes cross checking at the patient level to verify that: 1) all CABG surgeries discharged in 2003 and 2004 were reported; 2) all *Isolated* CABG surgery in-hospital deaths were reported; *3)* coding of *Discharge Status* was consistent; 4) *coding of Cardiogenic Shock* was consistent; and 5) coding of *Status of the Procedure* "Emergent/Salvage" was consistent.

Hospital Medical Chart Audit

A preliminary risk model was developed using combined 2003-2004 data that had passed through the data verification processes described above to identify outlier hospitals and surgeons (i.e., "Better" or "Worse" performers). The primary candidates for data audit were hospitals and surgeons identified as preliminary outliers, near outliers, or those possibly having problems in over-reporting or under-reporting risk factors. The 2004 data audit was much larger than the 2003 data audit and included 40 hospitals and a total of 2,824 records (12% of all CABG cases in 2004). An equal number of hospitals from Northern and Southern California were selected for the on-site medical chart review by trained, independent auditors. All isolated CABG deaths at the selected hospitals were audited and high risk patients were over-sampled. The number of cases selected within a hospital was proportional to the isolated CABG volume of the hospital, but with a range of 40 to 160 cases.

Key findings of the medical chart audit are presented below.

Overall results:

- There was modest improvement in the accuracy of hospital-submitted data from 2003 to 2004. In 2004, a total of 86,800 comparisons were performed for 31 categorical risk factors, which resulted in 9,324 data point corrections. When restricted to risk factors present in both audit years, the percentage of data corrections resulting from the audit dropped from 12.5% in year 2003 to 10.8% in year 2004.

- Over-reporting of categorical risk factors dropped from 5.2% in 2003 to 4.7% in 2004. Under-reporting of categorical risk factors dropped from 6.3% to 4.9% during the same period, and for continuous variables, the percentage of data corrections dropped 8%, over-reporting dropped 2%, and under-reporting dropped 5%.

- *Discharge status* was coded correctly for 99.9% of the audited cases. Two cases reported to CCORP as discharged alive were found to have died at discharge by the auditors. This was subsequently confirmed by hospitals. These two cases were not from the same hospital.

- The audit found that 99.2% of all reported isolated CABG cases were correctly coded as isolated. However, there were 24 isolated CABG cases reported to CCORP that auditors found to be non-isolated.

- The percent of missing values that would have been incorrectly assigned to the lowest risk category by default was low for most of the risk factors, indicating that missing data is not a major concern for the CCORP risk algorithm.

Specific Risk Factors:

- Using the percent of exact agreement between CCORP data submission and the audit data as an indicator of reporting reliability, the significant prognostic risk factors *Arrhythmia Type (Sustained VT/VF)* and *Cardiogenic Shock* showed strong agreement (96.8% and 95.9%, respectively). The audit also found at least 90% hospital-auditor agreement for *Patient Age, Gender, Dialysis, Immunosuppressive Treatment, Diabetes, Cerebrovascular Disease, Previous Operations with Cardio Pulmonary Bypass, PCI Interval, and Cerebrovascular Accident Timing.*

- Percent agreement is not a good measure of reporting accuracy for risk factors with low prevalence and kappa statistics were also consulted (not shown) in making determinations about inclusion of risk factors in the final model. Significant reporting problems were found for *Hepatic Failure*, *Arrhythmia Type (Heart Block),* and *Immunosuppressive Treatment* despite percent agreement of more than 90%. Hepatic Failure is a risk factor that exists for less than 0.5% of isolated CABG patients and auditors were able to confirm only 3 of the 29 diagnoses provided by hospitals. This risk factor has very strict reporting requirements and is difficult to code without complete laboratory documentation. After consulting with statisticians and the CCORP consulting cardiologist, it was determined that *Hepatic Failure* should be removed from the risk model.

- Percent agreement for *Arrhythmia Type (Heart Block)* was also relatively high, but auditors agreed with only 13 of the 70 diagnoses claimed by hospitals. This data element is incorporated into the overall categorical variable Arrhythmia Type, which showed good

overall agreement, and subsequently remained in the risk model. Auditors agreed with 33 of the 76 hospital diagnoses of *Immunosuppressive Treatment.* Over-reporting and under-reporting were of similar magnitude for this risk factor, which argued for its inclusion.

- The percent agreement was lower (<=80%) for *Status of the Procedure* (*Acuity*), *Chronic Lung Disease, Myocardial Infarction Timing, Mitral Insufficiency, NYHA Classification, and Angina Type.* Under-reporting was relatively high for *NYHA Classification* and *Angina Type.* This means that hospital submission of these variables, on average, incorrectly characterized patients as being lower risk. On the other hand, for the risk factors *Chronic Lung Disease* and *Myocardial Infarction Timing*, over-reporting was relatively high, indicating hospital submission of these risk factors incorrectly characterized patients as being higher risk. For the risk factor *Mitral Insufficiency,* there were equal levels of under- and over-reporting problems.

- Regarding *Status of the Procedure (Acuity),* a risk factor significantly affecting mortality, 111 records (4%) were coded in CCORP as Emergent or Emergent/Salvage while the audit found these were actually Elective or Urgent cases (over-reporting problem). Conversely, 55 records (2%) were coded as Elective or Urgent in CCORP while the audit reclassified these records as Emergent or Emergent/Salvage (under-reporting problem).

- For 2004, *NYHA Classification* I, II, and III were combined and served as the reference category in the risk model, with *NYHA Class IV* as the risk factor. Agreement statistics for NYHA Class using this approach improved slightly from 62% in the 2003 audit to 67% in 2004. This justified its retention in the risk model despite continued high levels of under-reporting (20%).

- As a result of substantial problems in the reporting of *Angina Type* (64.8% agreement) during this and previous audits, this variable was excluded from the risk-adjustment model.

At the end of the data correction process, the audited data were incorporated into the CCORP data for developing the public report and a summary of the audit report was sent to hospitals for review. All hospital outliers except one identified in the 2003-2004 ratings were audited either in 2003 or 2004. The one hospital not audited emerged as a statistical outlier very late in the process because of changes in other hospitals' relative rankings: it is targeted for audit next year. For surgeons, all outliers identified in the 2003-2004 ratings were audited without exception.

IV. 2003-2004 RISK MODEL FOR ADJUSTING HOSPITAL AND SURGEON OPERATIVE MORTALITY RATES

Hospital and surgeon performance are important factors that impact patient outcomes. Whether patients recover quickly, have complications, or die following CABG is in part a result of the medical care they receive. However, it is difficult to compare outcomes among providers in assessing performance because patients treated at different hospitals or by different surgeons often vary in the severity of their pre-operative clinical conditions.

To make fair comparisons of outcomes among different providers, it is necessary to adjust for the differences in the case mix of patients across hospitals and surgeons. CCORP "levels the playing field" by taking into account the pre-operative condition of each patient. Hospitals and surgeons who handle complex cases (i.e., sicker patients prior to surgery) get a larger risk-adjustment weighting in the risk model, while hospitals that handle less complex cases get a smaller weighting. Thus, hospitals and surgeons treating sicker patients are not at a disadvantage when their performance is compared with other hospitals and surgeons.

CCORP used a multivariable logistic regression model to determine the relationship between each of the demographic and pre-operative risk factors and the likelihood of operative mortality. Multivariable logistic regression models relate the probability of death to the explanatory factor (e.g., *Patient Age, Last Creatinine Level Preop*) while controlling for all other explanatory factors in the model.

The risk model was developed in two steps. In the first step, the 40,377 isolated CABG cases were evaluated for missing data; 36,510 of these had no missing data in any field and were used for the risk model parameter estimation. The 3,867 (10%) isolated CABG cases with missing data fields were removed to ensure that the effects of risk factors were estimated based on the most complete data available. In the second step, missing values for these 3,867 records were imputed by replacing them with the lowest risk category. CCORP assigned the lowest risk value based on the following rationale: 1) Many hospitals may leave data fields blank by design (e.g., blank means a risk factor was not present or the value was normal); 2) to maintain consistency with other major cardiac reporting programs where missing data are replaced with the lowest-risk or normal value; and 3) assigning values for missing data in this way creates an incentive for more complete reporting by hospitals. After imputing the missing values, the parameters of the risk model were applied to all data records for computation of hospital and surgeon expected mortality.

Although all pre-operative risk factors listed in Appendix B were candidates for the risk-adjustment model, only those associated with mortality in the expected direction from a clinical perspective were selected for the final model. Table 1 presents the final model based on the 2003 and 2004 dataset.

The final risk model included all variables used in the CCORP 2003 risk model[8] except *Hepatic Failure* (Yes/No) which was removed due to coding problems revealed in the medical chart audit.

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[8] Parker JP, Li Z, Danielsen B, Marcin J, Dai J, Mahendra G, Steimle AE. *The California Report on Coronary Artery Bypass Graft Surgery 2003 Hospital Data*, Sacramento, CA: California Office of Statewide Health Planning and Development, February 2006.

GUIDE TO INTERPRETING THE 2003-2004 LOGISTIC REGRESSION RISK MODEL

Coefficient	The coefficient for each explanatory factor represents the effect that a factor has on a patient's likelihood of dying (in the hospital or within 30 days) following bypass surgery. If the value is positive, it means that the characteristic is associated with an increased risk of death compared to not having the characteristic, while controlling for the effect of all other factors. If the coefficient is negative, having that characteristic is associated with a lower risk of death compared to not having it. The larger the value (whether positive or negative), the greater the effect or weight this characteristic has on the risk of dying. For example, the coefficient for "Congestive Heart Failure" in the 2003-2004 model is 0.26 and statistically significant. This value is positive, so it indicates that CABG patients with congestive heart failure are at an increased risk of dying compared to patients who do not have the disease.
Standard Error	The standard error is the standard deviation of the sampling distribution of an estimate. It measures the statistical reliability of that estimate.
p-value	The p-value is a measure of the statistical significance of the coefficient compared to the reference category. Commonly, p-values of less than 0.05 are considered statistically significant. The smaller the p-value, the more likely the effect of a factor is real rather than due to chance.
Significance	When the p-value of a coefficient is less than 0.05, it is deemed statistically significant at the 0.05 level and is denoted with one star (*). Two stars (**) indicate statistical significance at the 0.01 level, and three stars (***) indicate statistical significance at the 0.001 level. All statistical tests performed for this model are two-tailed.
Odds Ratio	An odds ratio (OR) is another way of characterizing the impact of each risk factor on operative mortality. Mathematically, the odds ratio is the antilogarithm of the coefficient value. The larger the odds ratio (above 1.0), the greater the impact that risk factor has on the risk of dying. An odds ratio of 1.0 means the factor has no effect. An odds ratio less than 1.0 means that the factor is associated with a decreased risk of dying. For example, the odds ratio for congestive heart failure (CHF) in the 2003-2004 model is 1.29. This means that for patients with CHF, the odds of dying is about 29% higher compared to patients without CHF, assuming all other risk factors are the same.

Table 1: Logistic Regression Risk Model for Operative Mortality, 2003-2004

Risk Factor		Coefficient	Standard Error	p-value	Significance	Odds Ratio
Intercept		-9.78	0.37	<.0001		
Age (by single year)		0.06	0.00	<.0001	***	1.06
Gender	Male			Reference		
	Female	0.47	0.07	<.0001	***	1.61
Race	Caucasian			Reference		
	Non-Caucasian	0.14	0.07	0.045	*	1.16
Body Mass Index	18.5-39.9			Reference		
	<18.5	0.71	0.21	0.001	***	2.03
	>=40.0	0.25	0.18	0.162		1.28
Status of Procedure	Elective			Reference		
	Urgent	0.43	0.09	<.0001	***	1.53
	Emergent	0.86	0.15	<.0001	***	2.37
	Emergent/Salvage	2.49	0.31	<.0001	***	12.01
Last Creatinine Level Preop (mg/dl)		0.99	0.14	<.0001	***	2.68
Hypertension		0.06	0.09	0.523		1.06
Dialysis		0.61	0.16	0.000	***	1.85
Peripheral Vascular Disease		0.37	0.08	<.0001	***	1.45
Cerebrovascular Disease		0.19	0.10	0.068		1.21
Cerebrovascular Accident	No CVA			Reference		
	Remote (>2 weeks)	0.06	0.12	0.622		1.06
	Recent (<=2 weeks)	0.52	0.36	0.150		1.69
Diabetes		0.05	0.07	0.483		1.05
Chronic Lung Disease	None			Reference		
	Mild	0.07	0.11	0.489		1.08
	Moderate	0.20	0.12	0.096		1.22
	Severe	0.77	0.13	<.0001	***	2.16
Immunosuppressive Treatment		0.38	0.17	0.02	*	1.47
Arrhythmia Type	None			Reference		
	Atrial Fibrillation/Flutter	0.40	0.10	<.0001	***	1.50
	Heart Block	0.16	0.17	0.349		1.18
	Sustained VT/VF	0.77	0.13	<.0001	***	2.15
Myocardial Infarction	None			Reference		
	21 or more days ago	0.02	0.10	0.848		1.02
	8-20 days ago	0.12	0.14	0.403		1.12
	1-7 days ago	0.08	0.09	0.358		1.08
	>6 but within 24 Hours	0.22	0.15	0.145		1.25
	Within 6 Hours	0.42	0.20	0.034	*	1.52
Cardiogenic Shock		0.99	0.12	<.0001	***	2.68
Congestive Heart Failure		0.26	0.08	0.001	***	1.29
NYHA Class IV		0.42	0.07	<.0001	***	1.52
Prior Cardiac Surgery	None			Reference		
	One or more	0.44	0.12	0.000	***	1.56
Prior PCI Interval	No Prior PCI			Reference		
	> 6 Hours	0.19	0.08	0.027	*	1.20
	<= 6 Hours	0.43	0.20	0.033	*	1.53
Ejection Fraction (%)		-0.01	0.00	<.0001	***	0.99
Left Main Disease (% Stenosis)		0.00	0.00	0.602		1.00
Number of Diseased Vessels	None, One, or Two			Reference		
	Three or more	0.39	0.09	<.0001	***	1.47
Mitral Insufficiency	None			Reference		
	Trivial	-0.03	0.12	0.777		0.97
	Mild	-0.07	0.10	0.454		0.93
	Moderate/Severe	0.25	0.12	0.039	*	1.28

Notes: Last creatinine level preop (mg/dl), ejection fraction, and percent left main stenosis were all modeled using piecewise linear transformations.
* significant at the 0.05 level (two-tailed test), ** significant at the 0.01 level (two-tailed test),
*** significant at the 0.001 level (two-tailed test)

Key Findings Regarding the Risk Model

- Although some of the risk factors are not statistically significant, all significant coefficients (p-value<0.05) appeared with the expected directional sign from a clinical standpoint, i.e., "+" for increased risk of dying and "-" for decreased risk of dying.

- Among demographic variables, *Patient Age, Gender,* and *Race* were all significant risk factors. The clinical literature suggests that *Gender* may be a proxy for body size and/or coronary artery size (diameter); smaller coronary arteries in women may be more prone to thrombosis or restenosis. For non-Caucasian patients, the probability of operative death was 16% higher than for Caucasian patients, controlling for all other variables.

- Patients who were very underweight (*Body Mass Index (BMI)* <18.5) had a higher risk of dying (Odds Ratio (OR)=2.03) than those in the reference group (*BMI* 18.5-39.9). Patients who were extremely obese (*BMI* ≥ 40.0) were also at increased risk of dying (Odd Ratio (OR)=1.28), although the association was not statistically significant. A very low *BMI* may be a proxy for frailty or indicate a wasting comorbid condition not captured by other risk variables.

- Of the comorbidities in the risk model, severe *Chronic Lung Disease* (OR=2.16), *Dialysis* (OR=1.85), and *Peripheral Vascular Disease* (OR=1.45) had strong associations with operative mortality. The risk factor *Last Creatinine Level Preop* (OR=2.68) also had a strong association with operative mortality.

- Of the cardiac risk factors, *Cardiogenic Shock* and the *Arrhythmia Type category* "Sustained VT/VF" had the largest effect (OR=2.68 and 2.15, respectively). *Congestive Heart Failure* also had a significant impact on operative mortality (OR=1.29).

- Controlling for all other variables, patients with prior cardiac surgery had a 56% greater chance of operative death after the CABG surgery.

- Among hemodynamic risk factors, *Ejection Fraction* had a significant effect on mortality (OR=0.99). Three or more *Diseased Vessels* also was a significant risk factor (OR=1.47). The Degree of *Left Main Disease* (% stenosis) did not independently contribute to the risk of operative mortality. Only moderate/severe *Mitral Insufficiency* was associated with an increased risk of death (OR=1.28).

Discrimination

Models that distinguish well between patients who die and those who survive are said to have good discrimination. A commonly used measure of discrimination is the c-statistic (also known as the area under the Receiver Operating Characteristic (ROC) curve. For all possible pairs of patients, where one dies and the other survives surgery, the c-statistic describes the proportion of pairs where the patient who died had a higher predicted risk of death than the patient who lived. The c-statistic ranges from 0.5 to 1, with higher values indicating better discrimination. For the 2003-2004 risk model, the c-statistic was 0.819. In recently published studies of CABG operative mortality using logistic regression models (including those from New Jersey and the National Society of Thoracic Surgeons), the c-statistic ranged from 0.76 to 0.78. In comparison, the CCORP 2003-2004 risk model appears to discriminate better than other programs that produce risk-adjusted outcomes data for isolated CABG surgery.

Calibration

Calibration refers to the ability of a model to match predicted and observed mortality across the entire spectrum of the data. A model in which the number of observed deaths matches closely with the number of deaths predicted by the model demonstrates good calibration. Good calibration is essential for reliable risk adjustment. A common measure of calibration is the Hosmer-Lemeshow χ^2 test, which compares observed and predicted outcomes over deciles of risk. The p-value of the Hosmer-Lemeshow test statistic for the risk model is 0.617, indicating a nonsignificant likelihood of poor calibration. That is, the predicted mortality was consistent with actual mortality in the data.

Another way to test model calibration is to partition the data and compare observed events (death) with predicted events (death) by risk group. As presented in Table 2, the first row shows the patients in the lowest risk group (i.e., their predicted mortality was less than 10%). Among the 34,442 patients in this group, 724 patients died, but the model predicted 713.3 patient deaths. Assuming a Poisson distribution for a binary outcome, the predicted range of deaths for this group is 660.9 to 765.6. The observed number of 724 deaths falls within the range of expected deaths. In fact, examination of all the risk groups shows no risk groups had deaths outside of the expected range and no systematic underestimates or overestimates of mortality at the extreme. More importantly, for the high risk groups (4 thru 10) the number of predicted deaths was either close to or slightly higher than the observed number of deaths, which indicates the model gives credit to providers who treat high-risk patients.

Table 2: Calibration of 2003-2004 Risk Model

Risk Group	Predicted mortality	N	Observed deaths	Predicted deaths	Difference	95% CI of Predicted deaths
1	<0.10	34,442	724	713.3	10.7	(660.9, 765.6)
2	0.10 – 0.19	1,392	193	189.4	3.6	(162.4, 216.3)
3	0.20 – 0.29	364	89	88.9	0.1	(70.4, 107.3)
4	0.30 – 0.39	167	50	57.6	-7.6	(42.7, 72.5)
5	0.40 - 0.49	68	31	30.3	0.7	(19.5, 41.1)
6	0.50 – 0.59	30	15	16.4	-1.4	(8.4, 24.3)
7	0.60 – 0.69	24	13	15.4	-2.4	(7.7, 23.1)
8	0.70 – 0.79	11	4	8.3	-4.3	(2.6, 13.9)
9	0.80 – 0.89	8	8	6.8	1.2	(1.7, 11.9)
10	0.90 – 1.00	4	3	3.7	-0.7	(0.0, 7.5)
Total		36,510	1,130	1.130		

V. RISK-ADJUSTED OPERATIVE MORTALITY AND HOSPITAL/SURGEON PERFORMANCE RATING

The risk-adjusted mortality rate (RAMR) represents the best estimate, based on the risk model, of what the provider's mortality rate would have been if the provider had a patient case mix identical to the statewide mix. Thus, this rate is comparable among providers since the differences in patient severity of illness have been accounted for. The RAMR is computed, first by dividing the observed mortality by the provider's expected mortality rate to get the observed/expected (O/E) ratio. If the O/E ratio is greater than one, the provider has a higher mortality than expected based on its patient mix; if the O/E ratio is less than one, the provider has a lower mortality rate than expected. The O/E ratio is then multiplied by the overall state mortality rate (3.08% for 2003-2004 combined; 3.29% for 2004 alone) to obtain the provider's risk-adjusted mortality rate.

To prevent a misinterpretation of differences caused by chance variation, the performance rating is based on a comparison of the 95% Confidence Interval (CI) of each provider's RAMR to the California state average mortality rate.[9] This was done because a point estimate of the RAMR based on just one or two years of data can be attributed to chance. Thus, we treated 2003-2004 data as a sample for inference. As shown in Tables 3, 4, and 5, if the entire 95% CI of a provider's risk-adjusted mortality is below the state average mortality rate, indicating the provider's RAMR is significantly lower than the state average, the performance rating will be **"Better"**; if the entire 95% CI of a provider's RAMR is above the state average mortality rate, indicating the provider's risk-adjusted mortality is significantly higher than the state average, the performance rating will be **"Worse"**; and if the state average mortality rate is within the 95% CI of a provider's RAMR, the performance rating will be **"Not Different"** (blank in the column).

2003-2004 Hospital Risk-Adjusted Operative Mortality Results

Table 3 and Figure 1 present the risk-adjusted results for each hospital for 2003-2004 combined. The table is sorted by geographic region and contains, for each hospital, the total number of CABG surgeries performed (isolated and non-isolated combined), the number of isolated CABG surgeries, the number of observed isolated CABG deaths, the observed mortality rate, the expected mortality rate predicted by the risk model, the risk-adjusted mortality rate and the 95% confidence interval (CI) of the risk-adjusted mortality rate, and the associated hospital performance rating.

To help the reader interpret the hospital performance rating, Figure 1 shows results graphically, sorted alphabetically by hospital name within geographic region. The vertical line on each bar represents the risk-adjusted mortality rate the each hospital, and the entire bar on the graph represents the 95% confidence interval (CI) of the risk-adjusted mortality rate for each hospital in a specific geographic region.[10] If the entire bar is positioned to the left of the vertical line indicating the state average, we conclude with 95% confidence that the hospital's risk-adjusted mortality is significantly lower than the state average ("Better"). If the entire bar is positioned to the right of the vertical line indicating the state average, we conclude with 95% confidence that

[9] The Poisson exact probability method was used for computation of 95% confidence interval for the risk-adjusted mortality rate. (Buchan Iain, *Calculating Poisson Confidence Interval in Excel*, January 2004)

[10] If there is no vertical line on the bar, the risk-adjusted mortality rate for the hospital is zero.

the hospital's risk-adjusted mortality is significantly higher than the state average ("Worse"), and if the bar crosses the vertical line, we conclude with 95% confidence that the hospital's risk-adjusted mortality rate is not different from the state average. For this report, the upper and lower portions of the 95% CIs are often not equal (unlike in the 2003 data report) since the Poisson exact probability method was used for computation of 95% CIs.

Among the 40,377 isolated CABG surgeries performed in 2003 and 2004, 1,244 patients died in-hospital or within 30 days of the surgery date, reflecting an overall operative mortality rate of 3.08% in California. The observed mortality rates among hospitals ranged from 0% to 12.73%. The expected mortality rates, which measure patient severity of illness, were between 1.23% and 5.42%. The risk-adjusted mortality rates, which measure hospital performance, ranged from 0% to 7.83%.

Based on the 95% confidence intervals for risk-adjusted mortality rates, 111 of 121 hospitals (91%) performed within the expected range compared to the state's overall mortality rate (denoted by a blank space in the performance rating column of Table 3), four of the 121 hospitals performed significantly **"Better"** than the state average, and six hospitals performed **"Worse"** than the state average. Hospital names marked with two asterisks (**) in Table 3 are hospitals that have submitted statements regarding this report. These are presented in Appendix C.

GUIDE TO INTERPRETING TABLES 3, 4 AND 5

All CABG Cases	The total number of isolated and non-isolated CABG cases submitted to CCORP for the time period indicated (i.e., 2003-2004, or 2004 alone). Non-isolated CABS cases are not used in calculating performance ratings.
Isolated CABG Cases	The number of isolated CABG cases submitted to CCORP during the time period indicated. Only isolated CABG cases are used in calculating performance ratings.
Isolated CABG Deaths	The actual number of operative deaths for isolated CABG cases for the time period indicated. The number of deaths includes: (1) all deaths that occur during the hospitalization in which the CABG surgery was performed, even after 30 days, and (2) all deaths occurring within 30 days after the CABG surgery.
Observed Mortality Rate	The ratio of the number of isolated CABG deaths and the isolated CABG cases multiplied by 100: Observed Mortality Rate = Number of Isolated CABG Deaths/Isolated CABG Cases X 100.
Expected Mortality Rate	The ratio of the expected number of operative deaths predicted for a provider (after adjusting for its patient population) and the number of Isolated CABG cases multiplied by 100: Expected Mortality Rate = Number of Expected Deaths/Number of Isolated CABG Cases X 100.
Risk-Adjusted Mortality Rate (95% CI)	The Risk-Adjusted Mortality Rate (RAMR) is obtained by multiplying the observed overall California mortality rate (CAMR) by a hospital/surgeon's O/E ratio: (CAMR X O/E ratio). The 95% confidence interval represents the confidence we have in the estimate for the RAMR. The lower and upper confidence limits are calculated using exact Poisson 95% confidence interval calculations.
Performance Rating	The performance rating is based on a comparison of each provider's risk-adjusted mortality rate and the California observed mortality rate. This is a test of statistical significance. A hospital or surgeon is classified as "Better" if the entire 95% confidence interval of the RAMR falls below the California observed mortality rate (3.08% for 2003-2004, 3.29% for 2004). A hospital or surgeon is classified as "Worse" if the entire 95% confidence interval of the RAMR is higher than the California observed mortality rate. A hospital or surgeon is classified as "Not Different" (performance rating is blank) if the California mortality rate falls within the confidence interval of the hospital's or surgeon's risk-adjusted mortality rate.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI		Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**				
Sacramento Valley & Northern California Region	Enloe Medical Center	454	366	9	2.46	3.13	2.42	(1.11, 4.59)	
	Mercy General Hospital	2,294	1,637	20	1.22	1.93	1.95	(1.19, 3.01)	Better
	Mercy Medical Center - Redding	588	486	10	2.06	3.85	1.65	(0.79, 3.03)	Better
	Mercy San Juan Hospital	315	238	4	1.68	1.95	2.65	(0.72, 6.80)	
	Redding Medical Center	57	42	3	7.14	5.41	4.06	(0.84, 11.88)	
	Rideout Memorial Hospital	381	318	6	1.89	2.69	2.16	(0.79, 4.70)	
	St. Joseph Hospital - Eureka	176	148	2	1.35	4.17	1.00	(0.12, 3.61)	
	Sutter Memorial Hospital	1,426	1,114	39	3.50	2.90	3.72	(2.64, 5.08)	
	UC Davis Medical Center	387	272	4	1.47	2.36	1.92	(0.52, 4.91)	
San Francisco Bay Area & San Jose	Alta Bates Summit Medical Center - Summit Campus	1,746	1,502	43	2.86	2.94	3.00	(2.17, 4.04)	
	California Pacific Medical Center - Pacific Campus	319	235	9	3.83	4.30	2.74	(1.25, 5.21)	
	Doctors Medical Center - San Pablo Campus	116	102	5	4.90	3.44	4.39	(1.43, 10.24)	
	Dominican Hospital	215	191	5	2.62	3.43	2.35	(0.76, 5.49)	

* A hospital is classified as "Better" if the upper 95% CI of the RAMR falls below the California observed mortality rate (3.08). A hospital is classified as "Worse" if the lower 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is considered "Not Different" from the state average (rating is blank) if the California mortality rate falls within the CI of the RAMR.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI	Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**			
San Francisco Bay Area & San Jose (continued)	El Camino Hospital	208	181	2	1.10	3.10	1.09 (0.13, 3.97)	
	Good Samaritan Hospital - San Jose	492	420	19	4.52	3.02	4.61 (2.78, 7.20)	
	John Muir Medical Center	227	177	6	3.39	2.52	4.14 (1.52, 9.02)	
	Kaiser Foundation Hospital (Geary San Francisco)	1,856	1,432	37	2.58	2.23	3.56 (2.51, 4.92)	
	Marin General Hospital	131	105	5	4.76	3.57	4.11 (1.33, 9.59)	
	Mt. Diablo Medical Center	543	440	17	3.86	3.16	3.76 (2.19, 6.03)	
	O'Connor Hospital	238	214	9	4.21	3.06	4.24 (1.94, 8.04)	
	Mills-Peninsula Health Center	177	132	2	1.52	3.57	1.31 (0.16, 4.72)	
	Queen of the Valley Hospital	380	339	7	2.06	3.99	1.59 (0.64, 3.28)	
	Salinas Valley Memorial Hospital	474	415	9	2.17	2.68	2.49 (1.14, 4.73)	
	San Jose Medical Center	97	88	4	4.55	4.53	3.09 (0.84, 7.91)	
	San Ramon Regional Medical Center	124	111	2	1.80	2.52	2.20 (0.27, 7.96)	
	Santa Clara Valley Medical Center	109	98	3	3.06	1.23	7.66 (1.58, 22.40)	

* A hospital is classified as "Better" if the upper 95% CI of the RAMR falls below the California observed mortality rate (3.08). A hospital is classified as "Worse" if the lower 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is considered "Not Different" from the state average (rating is blank) if the California mortality rate falls within the CI of the RAMR.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI		Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**				
San Francisco Bay Area & San Jose (continued)	Santa Rosa Memorial Hospital	271	206	17	8.25	4.37	5.81	(3.39, 9.31)	Worse
	Sequoia Hospital	448	245	5	2.04	3.60	1.75	(0.57, 4.07)	
	Seton Medical Center	498	438	7	1.60	3.26	1.51	(0.61, 3.11)	
	St. Helena Hospital	357	322	15	4.66	4.07	3.53	(1.97, 5.81)	
	St. Mary's Medical Center, San Francisco	190	140	7	5.00	5.32	2.89	(1.16, 5.96)	
	Stanford University Hospital	402	260	7	2.69	2.31	3.60	(1.44, 7.40)	
	Sutter Medical Center of Santa Rosa	319	241	1	0.41	1.72	0.73	(0.02, 4.14)	
	UCSF Medical Center**	315	270	16	5.93	3.35	5.45	(3.11, 8.85)	Worse
	Washington Hospital - Fremont	348	305	5	1.64	3.55	1.42	(0.46, 3.32)	
Central California	Bakersfield Heart Hospital	447	365	12	3.29	3.10	3.27	(1.69, 5.71)	
	Bakersfield Memorial Hospital	600	516	24	4.65	2.79	5.13	(3.29, 7.64)	Worse
	Community Medical Center - Fresno	512	446	16	3.59	3.92	2.82	(1.61, 4.58)	
	Dameron Hospital	152	125	10	8.00	4.27	5.77	(2.77, 10.61)	

* A hospital is classified as "Better" if the upper 95% CI of the RAMR falls below the California observed mortality rate (3.08). A hospital is classified as "Worse" if the lower 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is considered "Not Different" from the state average (rating is blank) if the California mortality rate falls within the CI of the RAMR.
** Hospital submitted a comment letter to OSHPD which is located in Appendix C.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI		Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**				
Central California (continued)	Doctors Medical Center - Modesto Campus	915	727	27	3.71	2.30	4.97	(3.28, 7.24)	Worse
	Fresno Heart Hospital	322	259	3	1.16	2.39	1.49	(0.31, 4.36)	
	Kaweah Delta Hospital	792	683	32	4.69	4.24	3.41	(2.33, 4.80)	
	Marian Medical Center	255	219	7	3.20	3.22	3.06	(1.23, 6.30)	
	Memorial Medical Center of Modesto	716	591	22	3.72	2.90	3.95	(2.48, 5.99)	
	San Joaquin Community Hospital	237	206	8	3.88	2.67	4.48	(1.93, 8.83)	
	St. Agnes Medical Center	897	772	20	2.59	2.75	2.90	(1.77, 4.48)	
	St. Joseph's Medical Center of Stockton	585	487	13	2.67	2.73	3.01	(1.60, 5.15)	
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara	Antelope Valley Hospital Medical Center	100	89	4	4.49	2.88	4.80	(1.31, 12.31)	
	Community Memorial Hospital of San Buenaventura	374	334	6	1.80	2.26	2.45	(0.90, 5.33)	
	Encino Tarzana Regional Medical Center	332	268	9	3.36	3.72	2.78	(1.27, 5.28)	
	French Hospital Medical Center	170	127	2	1.57	2.97	1.63	(0.20, 5.90)	
	Glendale Adventist Medical Center - Wilson Terrace	301	268	12	4.48	3.32	4.16	(2.15, 7.26)	

* A hospital is classified as "Better" if the upper 95% CI of the RAMR falls below the California observed mortality rate (3.08). A hospital is classified as "Worse" if the lower 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is considered "Not Different" from the state average (rating is blank) if the California mortality rate falls within the CI of the RAMR.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI		Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**				
San Fernando Valley, Antelope Valley, Ventura & Santa Barbara (continued)	Glendale Memorial Hospital and Health Center	348	299	14	4.68	3.24	4.45	(2.43, 7.47)	
	Granada Hills Community Hospital	25	25	0	0.00	5.01	0.00	(0.00, 9.07)	
	Lancaster Community Hospital	37	36	1	2.78	4.08	2.10	(0.05, 11.68)	
	Los Robles Regional Medical Center	332	271	13	4.80	3.75	3.94	(2.10, 6.74)	
	Northridge Hospital Medical Center	219	185	8	4.32	3.89	3.42	(1.48, 6.75)	
	Providence Holy Cross Medical Center	251	214	12	5.61	4.07	4.25	(2.19, 7.41)	
	Providence St. Joseph Medical Center	224	162	7	4.32	1.83	7.27	(2.92, 14.98)	
	Santa Barbara Cottage Hospital	493	385	8	2.08	3.18	2.01	(0.87, 3.97)	
	Sierra Vista Regional Medical Center	221	187	4	2.14	3.90	1.69	(0.46, 4.33)	
	St. John's Regional Medical Center	386	331	4	1.21	3.91	0.95	(0.26, 2.44)	Better
	Valley Presbyterian Hospital	68	68	4	5.88	3.06	5.92	(1.61, 15.16)	
	West Hills Regional Medical Center	117	100	3	3.00	3.11	2.97	(0.61, 8.68)	
Greater Los Angeles	Beverly Hospital	57	55	7	12.73	5.01	7.83	(3.15, 16.12)	Worse

* A hospital is classified as "Better" if the upper 95% CI of the RAMR falls below the California observed mortality rate (3.08). A hospital is classified as "Worse" if the lower 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is considered "Not Different" from the state average (rating is blank) if the California mortality rate falls within the CI of the RAMR.

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Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI	Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**			
Greater Los Angeles (continued)	Brotman Medical Center	81	59	2	3.39	2.86	3.65 (0.44, 13.19)	
	Cedars Sinai Medical Center	649	423	10	2.36	2.96	2.46 (1.18, 4.52)	
	Centinela Hospital Medical Center	216	196	10	5.10	3.29	4.77 (2.29, 8.78)	
	Citrus Valley Medical Center - IC Campus	364	323	12	3.72	3.02	3.79 (1.96, 6.62)	
	Downey Regional Medical Center	147	145	7	4.83	3.22	4.62 (1.86, 9.51)	
	Garfield Medical Center	229	194	4	2.06	3.54	1.79 (0.49, 4.59)	
	Good Samaritan Hospital - Los Angeles	671	528	19	3.60	3.97	2.79 (1.68, 4.36)	
	Huntington Memorial Hospital	386	288	6	2.08	2.33	2.75 (1.01, 5.99)	
	Kaiser Foundation Hospital (Sunset Los Angeles)	2,293	1,967	62	3.15	2.75	3.53 (2.71, 4.53)	
	Lakewood Regional Medical Center	299	262	14	5.34	2.85	5.77 (3.16, 9.69)	Worse
	Little Company of Mary Hospital	228	169	5	2.96	4.36	2.09 (0.68, 4.88)	
	Long Beach Memorial Medical Center	752	648	28	4.32	3.10	4.29 (2.85, 6.20)	
	Los Angeles Co Harbor - UCLA Medical Center	284	263	10	3.80	3.39	3.45 (1.66, 6.35)	

* A hospital is classified as "Better" if the upper 95% CI of the RAMR falls below the California observed mortality rate (3.08). A hospital is classified as "Worse" if the lower 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is considered "Not Different" from the state average (rating is blank) if the California mortality rate falls within the CI of the RAMR.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI	Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**			
Greater Los Angeles (continued)	Los Angeles Co USC Medical Center	284	231	6	2.60	2.15	3.72 (1.37, 8.10)	
	Methodist Hospital of Southern California	235	216	8	3.70	2.80	4.07 (1.76, 8.03)	
	Presbyterian Intercommunity Hospital	175	158	5	3.16	3.69	2.64 (0.86, 6.16)	
	Santa Monica - UCLA Medical Center	86	70	2	2.86	3.03	2.91 (0.35, 10.49)	
	St. Francis Medical Center	186	174	6	3.45	2.41	4.41 (1.62, 9.59)	
	St. John's Hospital and Health Center	192	150	1	0.67	2.47	0.84 (0.02, 4.63)	
	St. Mary Medical Center	162	137	7	5.11	5.22	3.02 (1.21, 6.21)	
	St. Vincent Medical Center	443	387	10	2.58	3.69	2.15 (1.03, 3.97)	
	Torrance Memorial Medical Center	384	284	5	1.76	3.65	1.49 (0.48, 3.47)	
	UCLA Medical Center	355	205	7	3.41	2.65	3.96 (1.60, 8.18)	
	USC University Hospital	356	224	14	6.25	3.57	5.39 (2.95, 9.05)	
	White Memorial Medical Center	260	239	9	3.77	4.16	2.79 (1.27, 5.29)	
Inland Empire, Riverside & San Bernardino	Desert Regional Medical Center	378	323	15	4.64	3.29	4.34 (2.43, 7.17)	

* A hospital is classified as "Better" if the upper 95% CI of the RAMR falls below the California observed mortality rate (3.08). A hospital is classified as "Worse" if the lower 95% CI of the RAMR is higher than the California observed mortality rate. A hospital's performance is considered "Not Different" from the state average (rating is blank) if the California mortality rate falls within the CI of the RAMR.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

Region	Hospital	All CABG Cases	Isolated CABG Cases	Isolated CABG Deaths	Observed Mortality Rate (%)	Expected Mortality Rate (%)	Risk-Adjusted Mortality Rate (%, RAMR) and 95% CI	Performance Rating*
State		**49,435**	**40,377**	**1,244**	**3.08**			
Inland Empire, Riverside & San Bernardino (continued)	Eisenhower Memorial Hospital	533	409	13	3.18	3.35	2.92 (1.56, 5.00)	
	Loma Linda University Medical Center	825	628	14	2.23	2.81	2.44 (1.34, 4.10)	
	Pomona Valley Hospital Medical Center	383	322	8	2.48	4.73	1.61 (0.70, 3.19)	
	Riverside Community Hospital	556	497	17	3.42	3.62	2.91 (1.70, 4.66)	
	San Antonio Community Hospital	147	136	3	2.21	5.42	1.26 (0.26, 3.66)	
	St. Bernardine Medical Center	1,148	1,035	25	2.42	3.30	2.26 (1.46, 3.33)	
	St. Mary Regional Medical Center	492	445	12	2.70	3.58	2.32 (1.20, 4.05)	
Orange County	Anaheim Memorial Medical Center	542	480	19	3.96	3.16	3.86 (2.32, 6.02)	
	Fountain Valley Regional Hospital	295	268	4	1.49	4.20	1.09 (0.30, 2.80)	Better
	Hoag Memorial Hospital Presbyterian	615	453	13	2.87	4.10	2.16 (1.15, 3.69)	
	Irvine Regional Hospital and Medical Center	82	75	2	2.67	1.99	4.13 (0.50, 14.91)	
	Mission Hospital Regional Medical Center	457	394	6	1.52	2.22	2.11 (0.78, 4.60)	
	Saddleback Memorial Medical Center	266	227	7	3.08	2.79	3.40 (1.37, 7.01)	

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State		**49,435**	**40,377**	**1,244**	**3.08**			
Orange County (continued)	St. Joseph Hospital - Orange	427	327	3	0.92	2.58	1.10 (0.23, 3.20)	
	St. Jude Medical Center**	423	371	14	3.77	2.51	4.63 (2.53, 7.77)	
	UC Irvine Medical Center	187	153	7	4.58	2.51	5.62 (2.26, 11.57)	
	West Anaheim Medical Center	52	52	4	7.69	3.16	7.50 (2.04, 19.20)	
	Western Medical Center - Santa Ana	233	212	4	1.89	2.57	2.27 (0.62, 5.79)	
	Western Medical Center Hospital - Anaheim	360	333	11	3.30	2.61	3.89 (1.95, 6.97)	
Greater San Diego	Alvarado Hospital Medical Center	212	185	8	4.32	2.57	5.18 (2.24, 10.21)	
	Palomar Medical Center	289	259	11	4.25	2.28	5.74 (2.86, 10.27)	
	Scripps Green Hospital	311	238	9	3.78	2.22	5.25 (2.40, 9.96)	
	Scripps Memorial Hospital - La Jolla	1,023	772	25	3.24	3.67	2.72 (1.76, 4.01)	
	Scripps Mercy Hospital	344	270	14	5.19	3.31	4.83 (2.64, 8.10)	
	Sharp Chula Vista Medical Center	513	446	11	2.47	4.19	1.82 (0.91, 3.24)	
	Sharp Grossmont Hospital	367	315	7	2.22	3.14	2.18 (0.88, 4.49)	

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** Hospital submitted a comment letter to OSHPD which is located in Appendix C.

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Table 3: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

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State		**49,435**	**40,377**	**1,244**	**3.08**			
Greater San Diego (continued)	Sharp Memorial Hospital	535	346	4	1.16	2.24	1.60 (0.43, 4.07)	
	Tri - City Medical Center	320	260	6	2.31	2.53	2.81 (1.03, 6.11)	
	UCSD Medical Center	83	67	1	1.49	4.14	1.11 (0.03, 6.19)	
	UCSD Medical Center - La Jolla	157	109	5	4.59	4.35	3.25 (1.05, 7.58)	

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Figure 1: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004

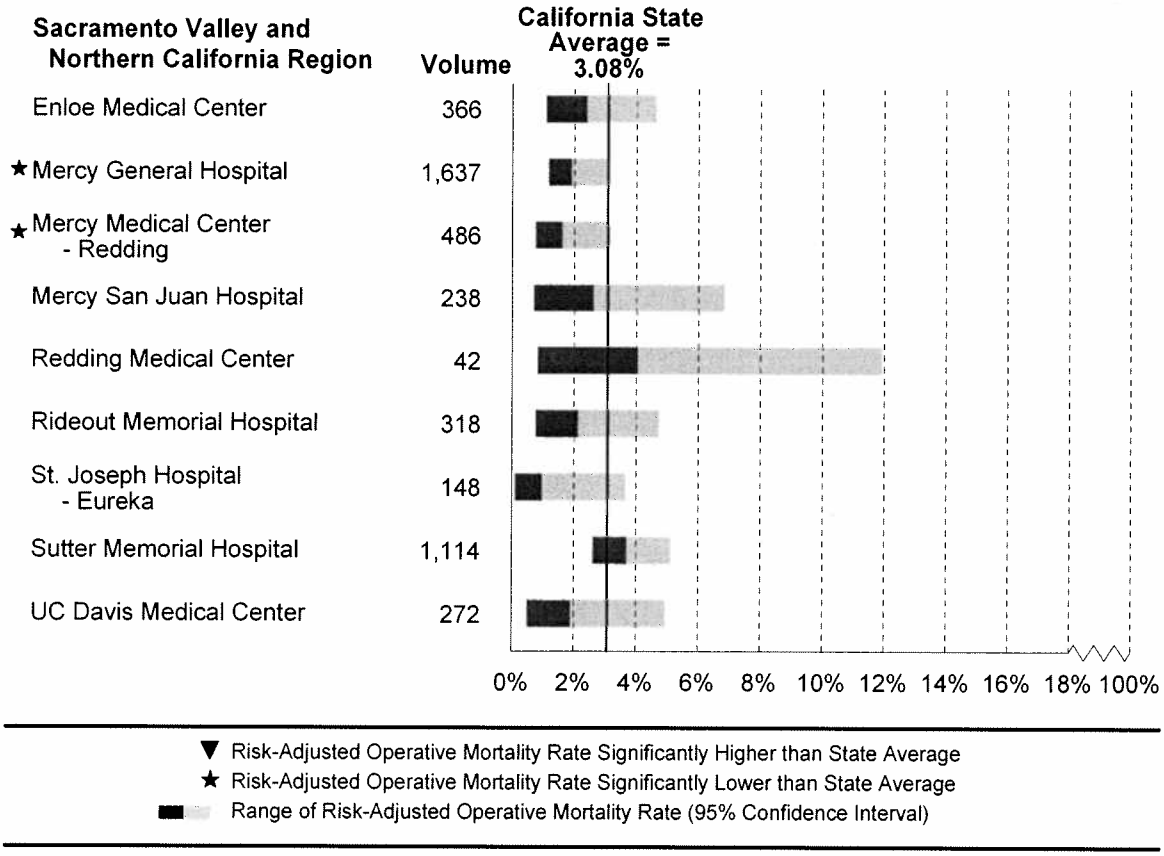
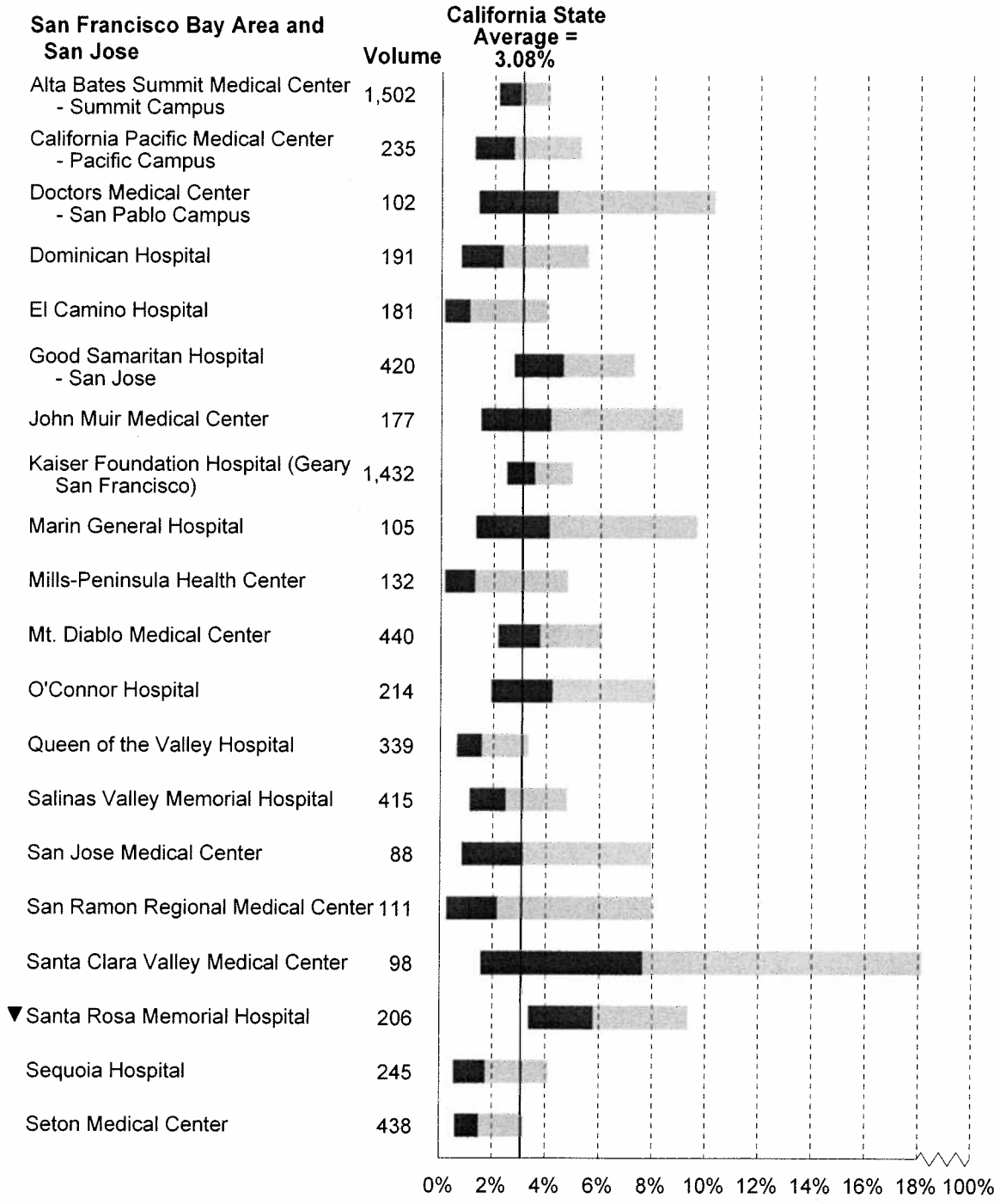


Figure 1: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004 (cont'd)



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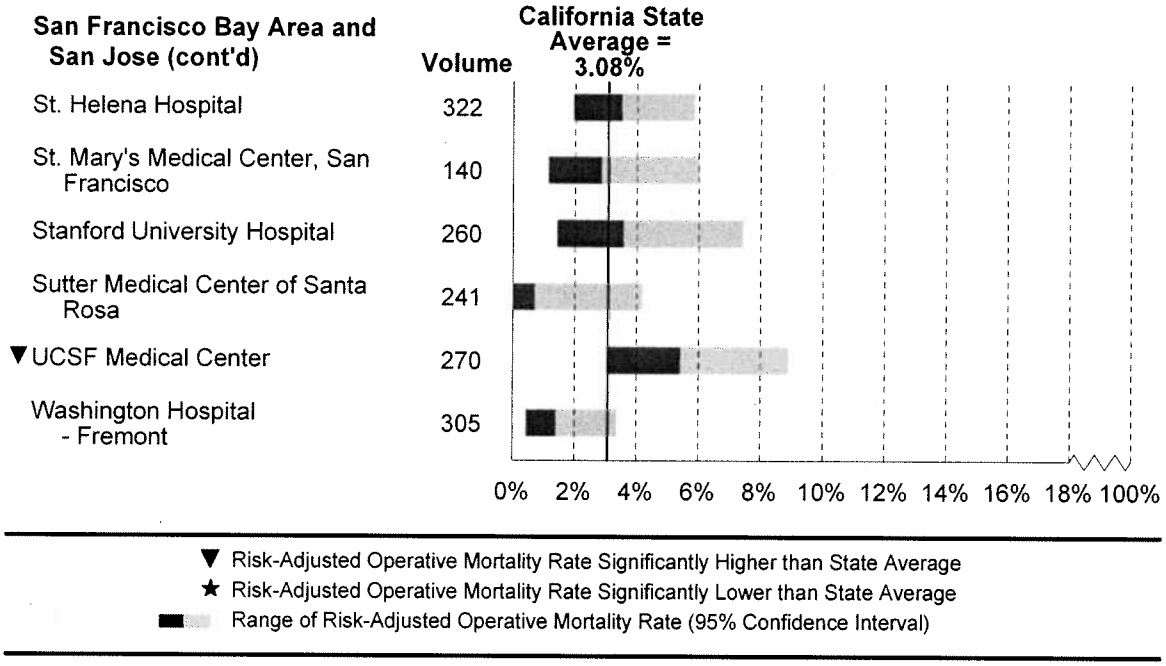


Figure 1: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004 (cont'd)

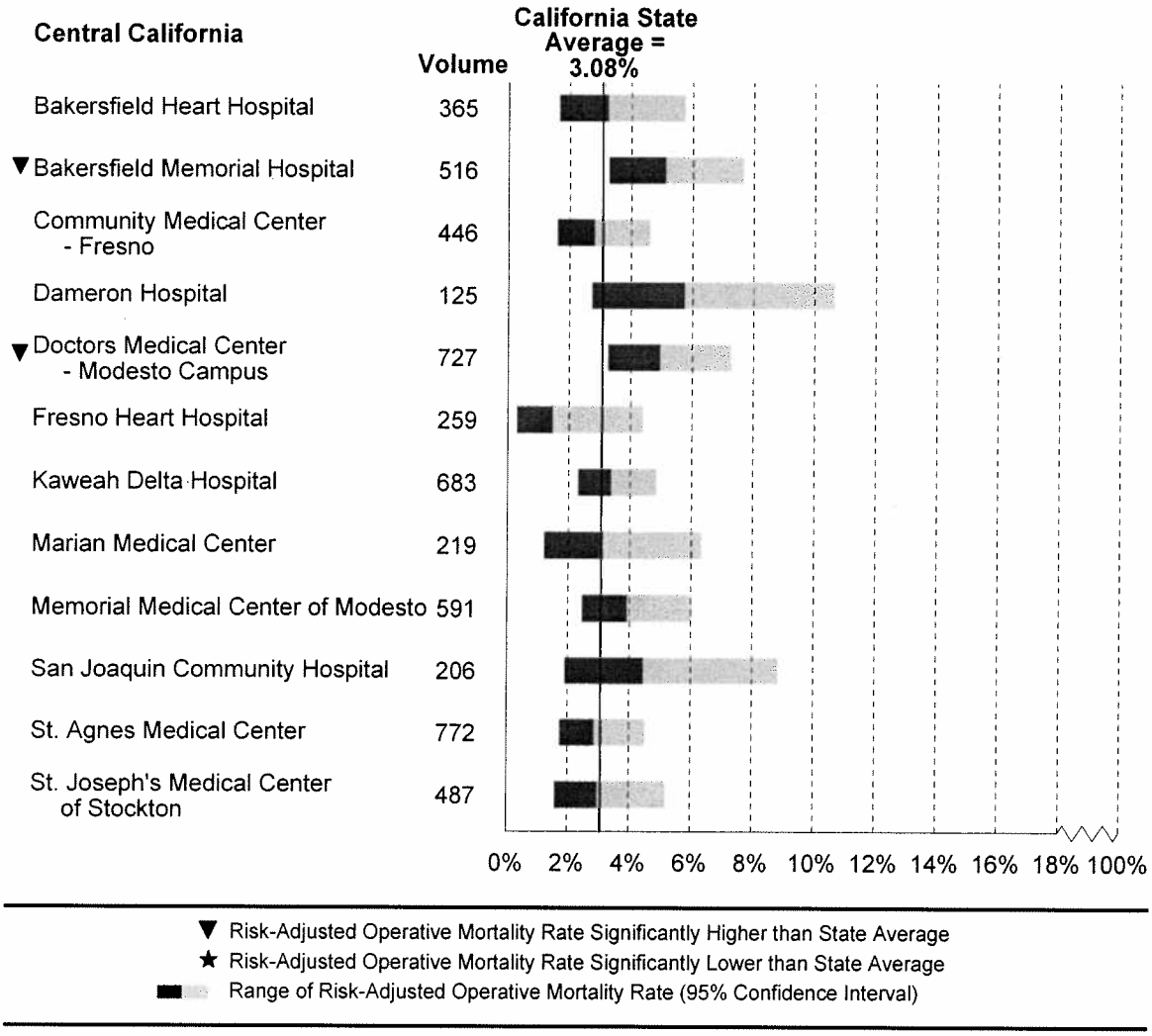
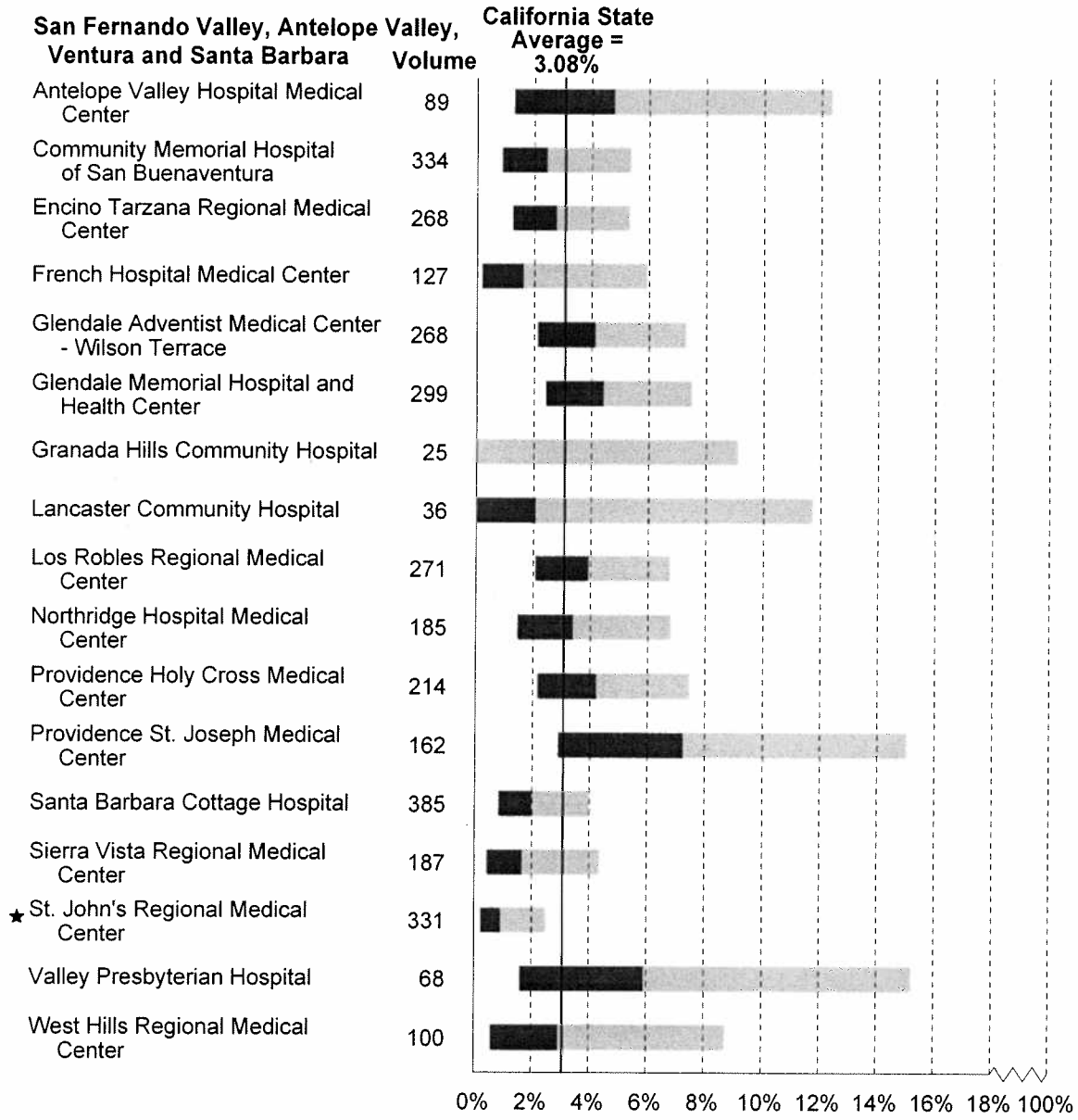


Figure 1: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004 (cont'd)



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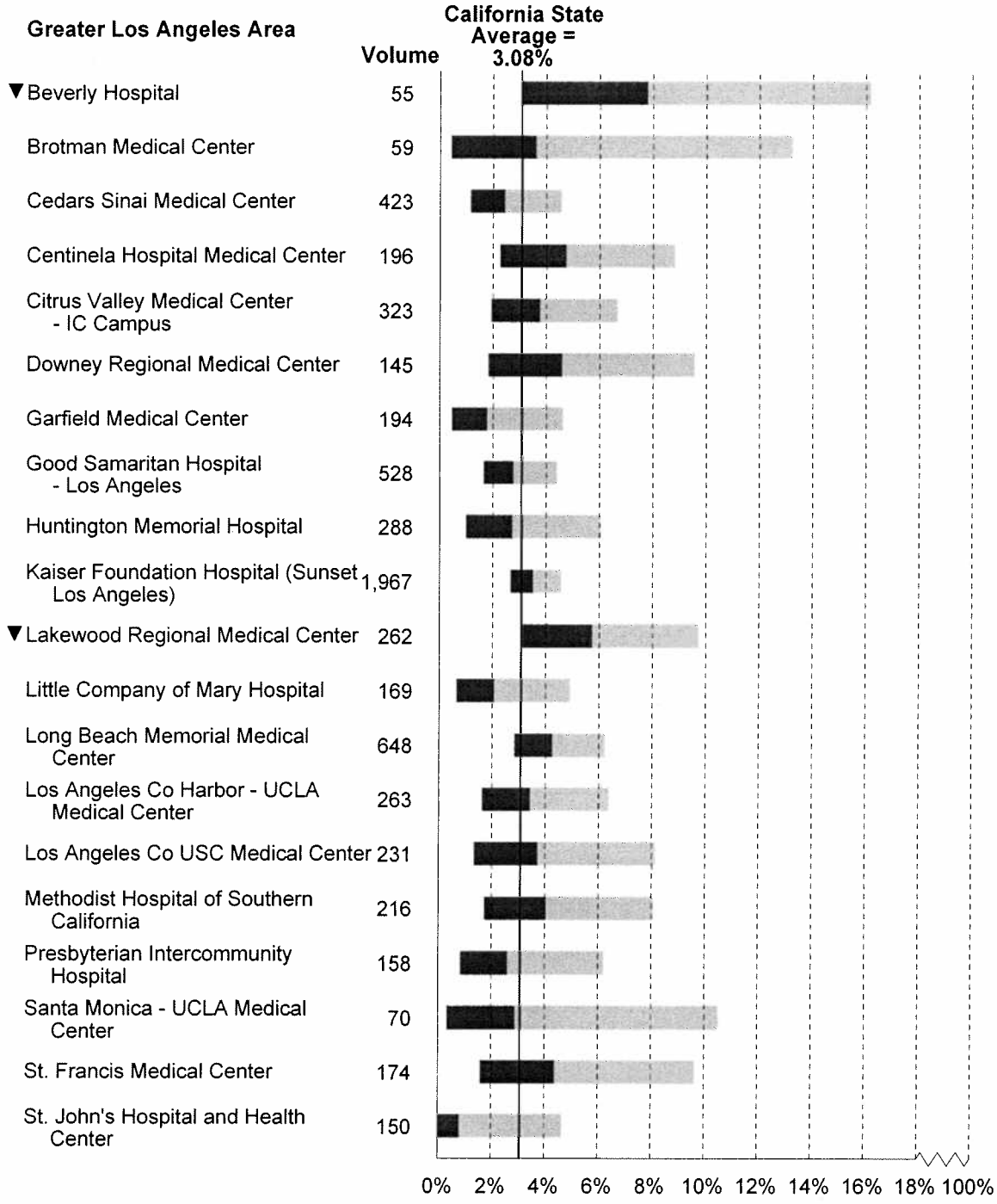


Figure 1: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004 (cont'd)

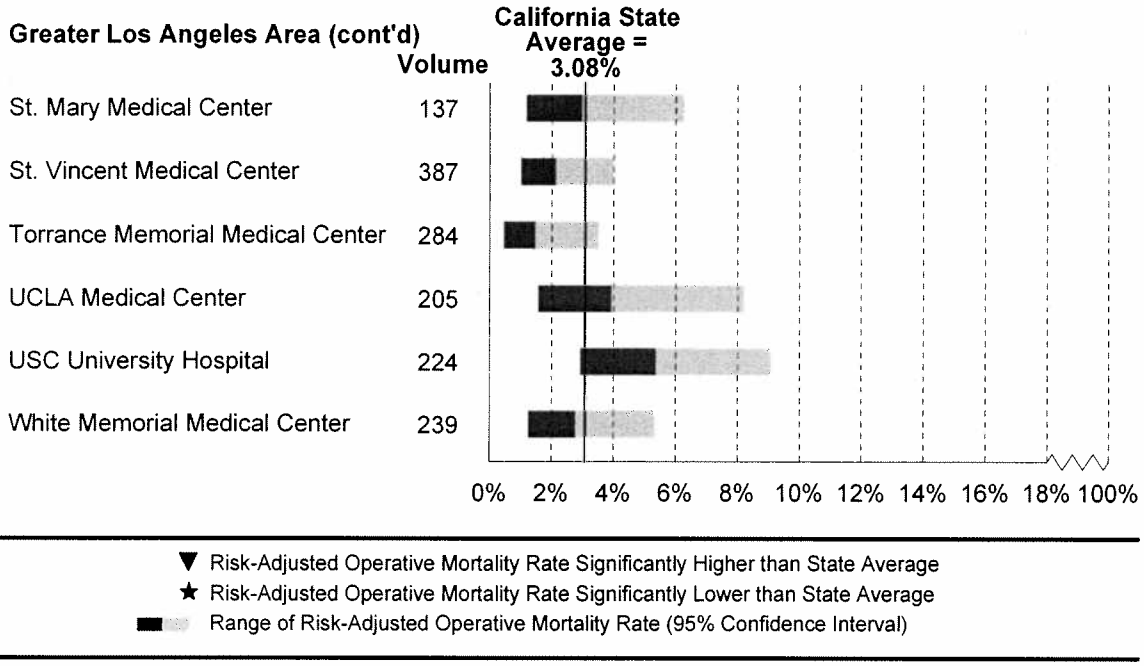
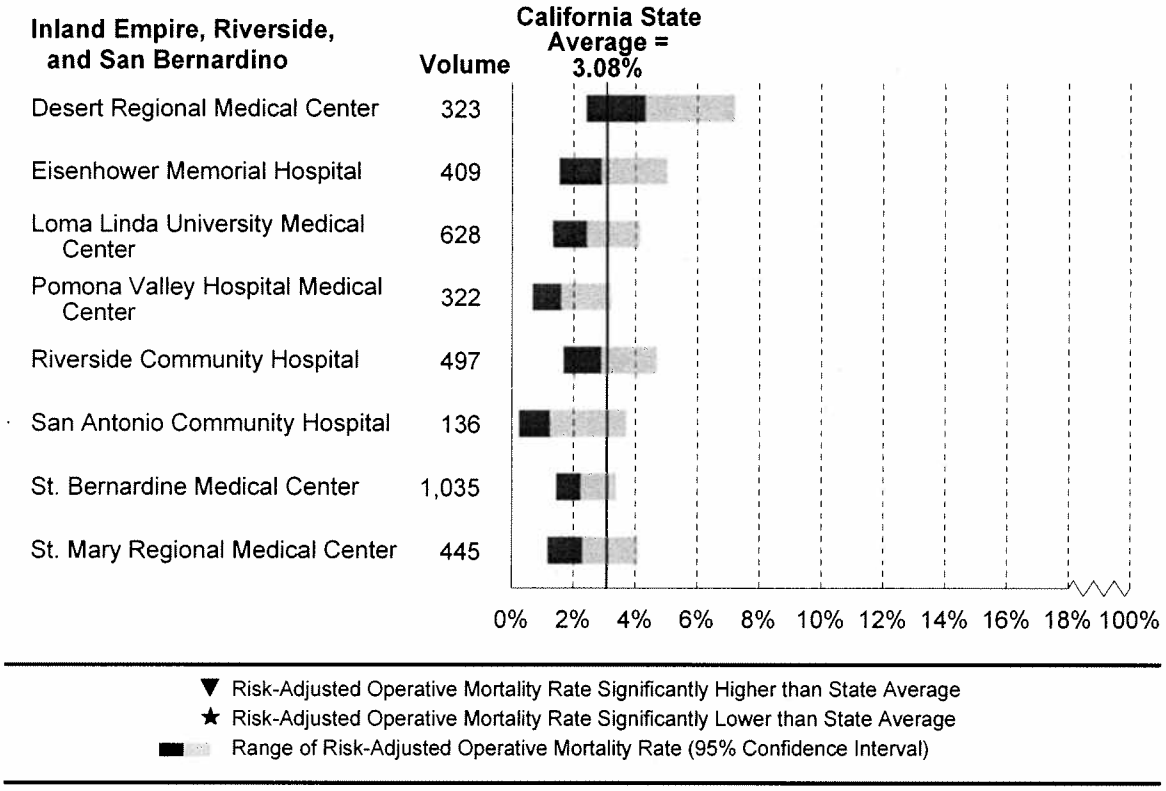


Figure 1: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004 (cont'd)



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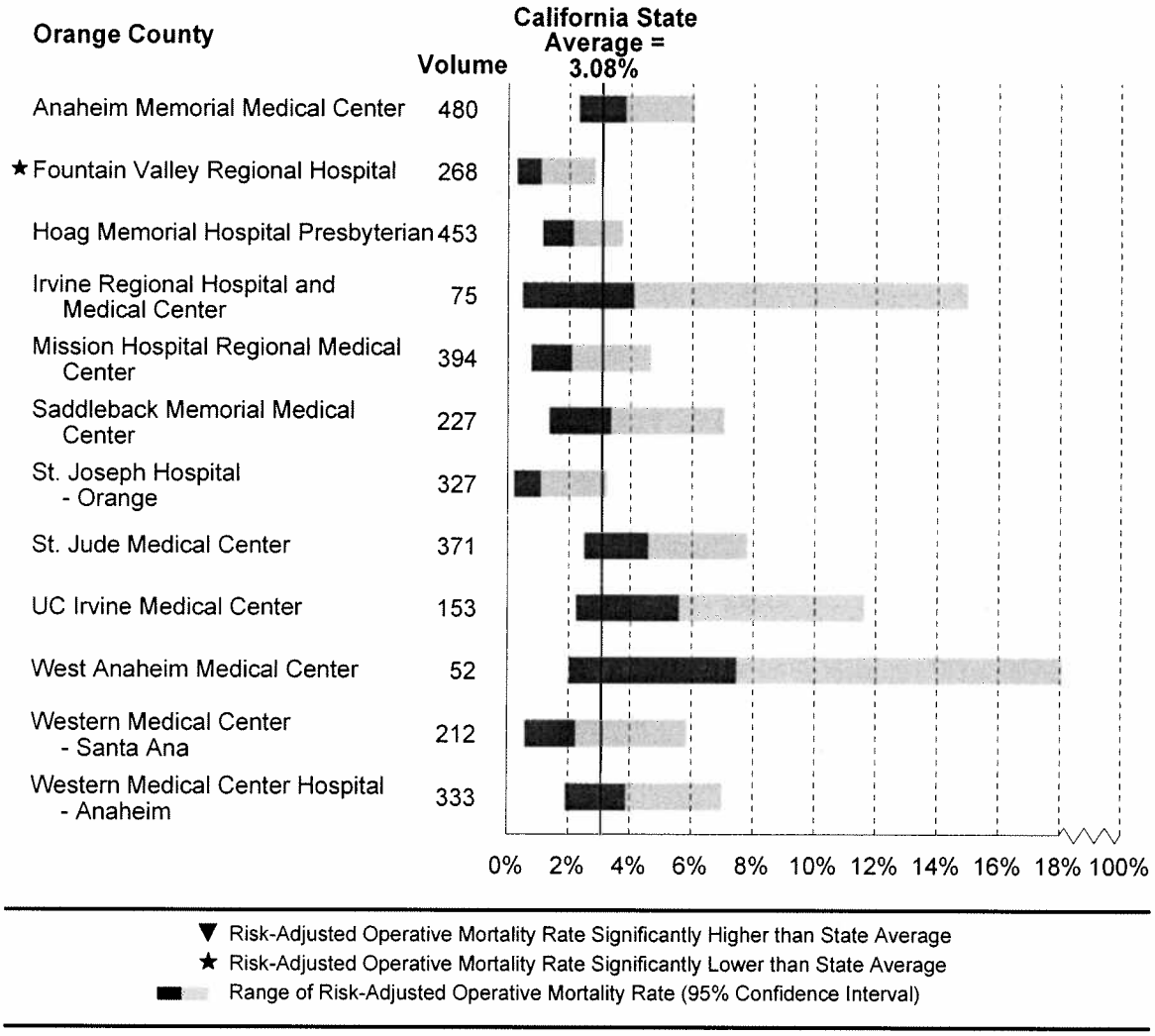
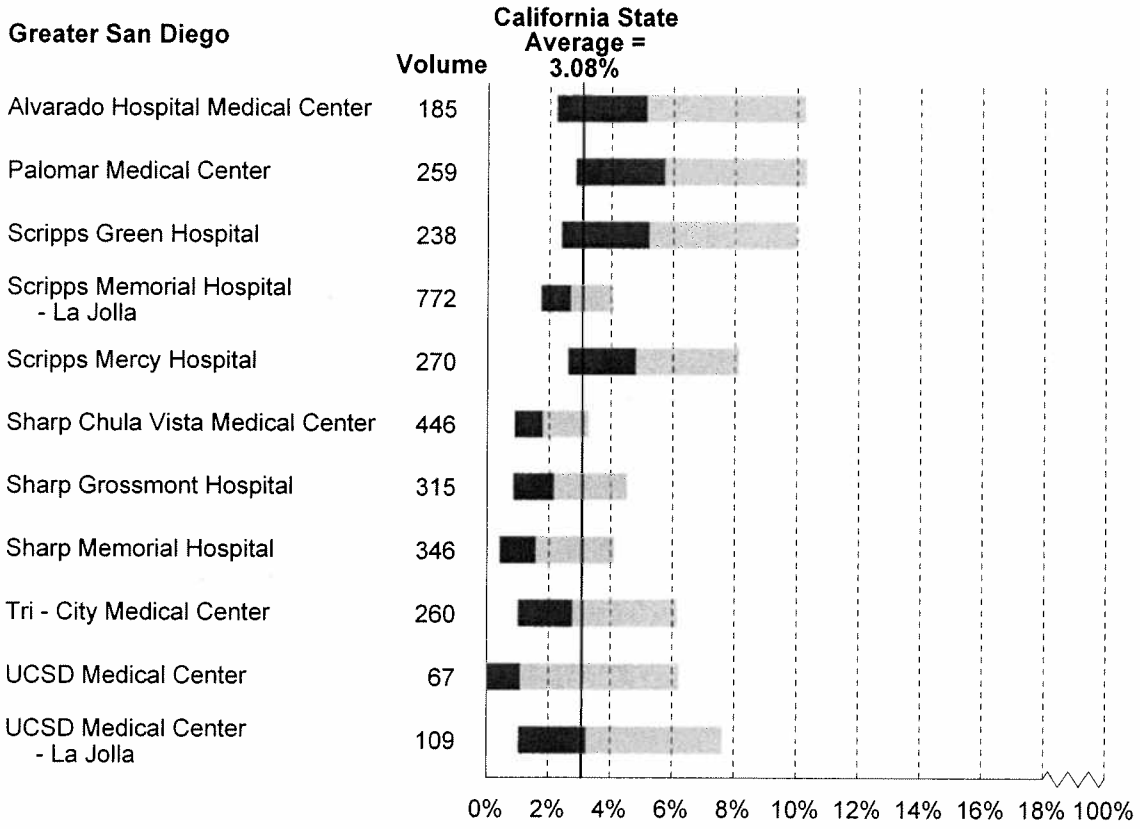
Figure 1: Hospital Risk-Adjusted Operative Mortality Results by Region, 2003-2004 (cont'd)